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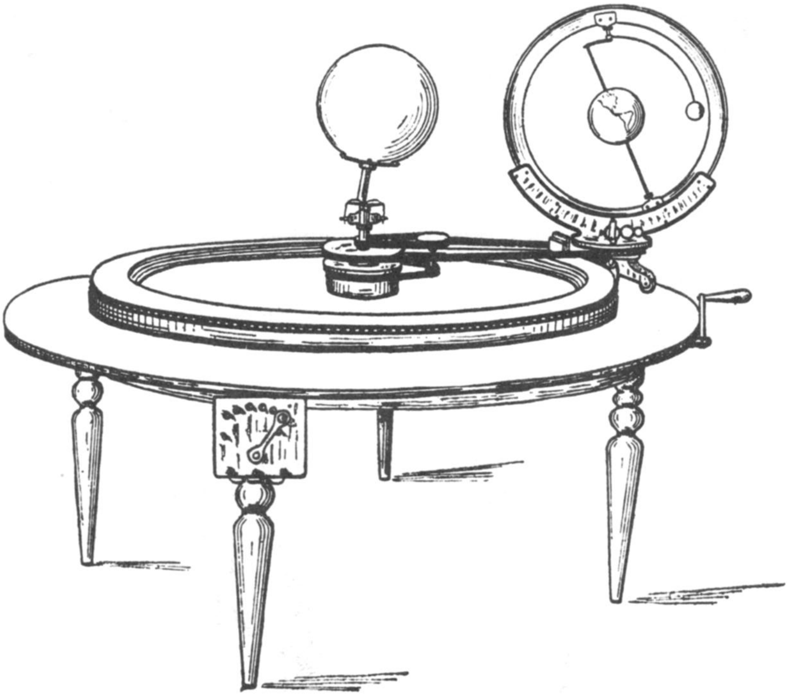
THE THIRD MOVEMENT OF THE EARTH

[During the World's Fair at St. Louis the Editor of *The Monist* renewed acquaintance with a French professor, M. C. A. Guerard, who at that time was in charge of a planetarium that had been built for the special purpose of exhibiting a working instance of a condition in our planetary movements, which the discoverer, M. P. Beziau, calls "the third movement." An inspection of the "Demonstrator," as M. Beziau calls his planetarium, showed that this third movement is a truth demonstrable through the facts of planetary rotations which will at the same time easily explain the retrograde movement of some of our planets. It is strange that this third movement has not found the recognition which it appears to deserve.

Upon further inquiry the Editor made the acquaintance of M. Beziau himself who is a man of peculiar talents. He is not a professional astronomer, but an able mechanician who has devised his Demonstrator all by himself and has constructed the machinery so as to exhibit this third movement, which is of great importance in our explanation of the several planetary ecliptics, and will enable us to predict the fate of our world in coming millenniums.

M. Beziau's theory has been discussed in astronomical circles of France, and M. Flammarion has spoken of it in high terms and given it a good recommendation. If it has not been noticed in broader circles it is probably due to the fact that M. Beziau is not a specialist in astronomy and that at the same time he possesses a streak of mysticism which makes him in many respects uncritical. In a personal interview with the Editor for instance, M. Beziau expressed a belief that the ancient Hindus, Egyptians, and Assyrians possessed a knowledge of this law which later became obscured through centuries of ignorance. This theory he founds on the evidences of mystical reconstructions of ancient history, the authority of which he seemed to accept without criticism. But while M. Beziau is apparently onesided, our confidence in his theory has not been shaken, and we believe that it deserves the attention of the world. Accordingly, we have taken pains to procure a sufficiently detailed and accurate statement of it, presented in his own words. It has been translated by Miss Lydia G. Robinson from the report of an interview made by M. Léon Maillard for the *Revue Illustrée,* and we submit it here for those competent to judge of the merits of M. Beziau's hypothesis.—ED.]

THE Demonstrator consists of a glass globe representing the sun, which stands isolated in the center of a table; a car supporting a hollow metal circle crossed by an axis passing through the smaller globe at its center which represents the earth; and at the end of the axis is fastened a stem parallel to the circumference of the circle and bearing at its end the small moon which is to play its part as satellite to the earth. The motion is controlled by a chain and the power may be furnished by electricity or by hand. There is a crank by means of which the apparatus may be set in motion in whatever direction and at what ever angle is desired.



THE DEMONSTRATOR.

If we make the apparatus move continuously and confine ourselves especially to examining the different positions of the earth, a part of the mysteries which sleep in the depths of the geological ages will be unveiled before us with the same facility that some celestial mysteries will be disclosed.

Let us place the axis of daily rotation at the actual angle of inclination of the earth, 23° 27′. It is now in the act of straightening itself into the vertical position. What will be the consequences of this straightening, for the various latitudes? At the equator the sun will deviate less and less from the equatorial line which it will not leave again while the axis is perpendicular. For this latitude this will be the period of excessive heat.

On the other hand the two poles will become cold as a consequence of this straightening. They will pass through the most rigorous glacial period when the axis is perpendicular. In fact the poles will not see the sun again. The ice cap will be of considerable extent. It will form a powerful condensor where the vapors of the torrid zone will be solidified. The glaciers will descend from the poles, approaching each other as they have already done to about 60°.

When the axis is perpendicular what will the temperature be at 45°? It will be the same all the year around, mild in the plains without rising, and low in the mountains. The evaporation being very great, the glaciers will descend from the mountain peaks. They will invade the plateaus to the extreme limits that they have formerly occupied. This will be the period of the most universal glacial extension.

If the axis continues its motion, the angle of inclination will change. The glaciers will draw back from the poles and the mountains and be reduced to their present extent when the axis will again have reached the position of 23° 27′, but it will continue farther in its movement, and the glaciers will continue to withdraw.

When the inclination reaches an angle of 45° there will cease to be any remnant of the ice age upon the earth.

The poles will be entirely freed, the winters will be dry and the summers warm. At the poles a day will be three months long, and will be followed by a night of the same length. This will be the period in which the existence of life will be developed most generally over the entire surface of the earth. The poles will again be covered with luxuriant vegetation.

Continuing its motion, the axis will later assume a horizontal position. What will be the effect of this position upon the temperature at different latitudes? Each year the equator will see two long winters and two very short summers. For this latitude it will be the period of the greatest glacial extension. The glaciers will descend from the mountains. The lowest part of Africa and Asia which is to-day covered with sand will be covered with water. The poles at this time will experience a very exceptional temperature. Each will have an alternate day and night of six months. We can have no idea of the degree of temperature which the atmosphere can attain during this day of six months, when the sun's rays will be directed vertically upon the ground. It is by this high temperature that I explain the excessive expansion of the soil by which Norwegian lands have been raised 150 meters and those of Canada 300 meters above sea-level.

Another geological mystery is explained by this horizontal position of the axis of diurnal rotation. (It is only this axis that we shall discuss. It serves us as a point of reference.) Geologists have ascertained that our rivers in the distant past contained twenty times as much water as they do to-day; they have even proved several periods of extensive water courses. These periods have taken place when the axis occupied the horizontal position.

During the long night which covers one of the hemispheres while the other is bathed in solar rays the vapors become condensed and snow accumulates in large quantities. But all the snow melts at about the same time when the sun rises to the horizon, and the result is an extraordinary inundation occurring alternately in the two hemispheres.

But let the axis still continue its motion and for the second time it will begin to occupy all the several positions which we have observed. In the time of a complete rotation it passes through two horizontal periods and two vertical periods.

We have noticed that the periods of great glacial extension at the poles were simultaneous with each other, but not with the equator. For a long time men have sought in vain the explanation of the discoveries made by explorers in the polar regions. This explanation will now be disclosed very naturally.

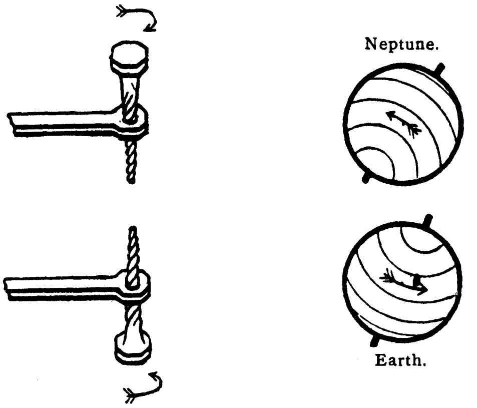
We have seen that the poles pass successively through the glacial and estival periods. Is it then surprising that vestiges of vegetation have been found at the poles under the ice that exists there to-day, and the relics of mammoths and fossils under the vegetable mold? The sudden disappearance of the mammoth in Siberia may be explained very simply. It was not at a very remote age, the date can be fixed at about fifty thousand years ago.

You are familiar with the fact that the earth turns upon its axis in twenty-four hours, the axis being inclined at an angle of 23° 27′ with reference to the perpendicular to its path of rotation around the sun. Every one is familiar with this rotation. It was the subject of much discussion in former days, but since the time of Copernicus and Galilei it is no longer disputed.

But there is another rotation of the earth which although well known seems to have been forgotten. This is the annual rotation.

You know that in industrial mechanics it is necessary at the risk of serious error to refer each movement in rotary movements not to its particular center but to the absolute center of the collection of movements. The same law governs the movements of the celestial bodies. It is by imagining oneself in the center of the sun that the rotation of the moon was discovered. If we will observe the earth from this central point we will notice that it presents successively all the points of its surface to the sun. In order to do this it is necessary that it turn upon itself. A simple experiment will determine the direction of this rotary movement which is distinct from the daily movement and its angular velocity of rotation.

Take in your hand a globe to represent the earth. Direct the axis of diurnal rotation towards any point in space. Stretch out your arm and turn slowly around supposing yourself to occupy the place of the sun. The globe will change its position but with it also will be changed the direction of its axis of daily rotation. Evidently this is not the way in which the earth turns around the sun, but you will succeed in imitating the exact movement of the earth if you will communicate a rotary movement to the bottom of the globe by the aid of your free hand. The



The planets change the direction of their rotation when their axes are reversed, as is the case with screws.

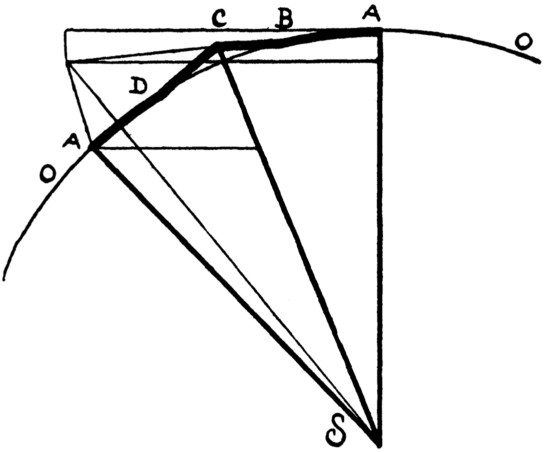
base of the globe will turn in your hand. The movement that you will have impelled is a retrograde movement, and its velocity is proportionate to your own rotary motion. When you will have accomplished a complete rotation you will have caused the globe to complete a rotation about itself in the opposite direction from its own rotary movement.

Hence the earth rotates upon itself in the opposite direction from its change of position in space during the time that it makes a rotation around the sun. This retrograde rotation is annual. It takes place around an axis which is ideal or potential in space, and perpendicular to the plane of its orbit. This axis has no fixed point in the interior of the earth. Its rotation is common to all the planets, wherefore we can formulate the following law:

The planets turn about themselves on an ideal axis perpendicular to the plane of their orbit in an opposite direction from their movement around the sun and in a time equal to that of their revolution.

From this movement which is of a purely mechanical nature and can be demonstrated geometrically, it results that the earth is a free body around its own center of gravity and that solar action can be felt upon it only by this center of gravity. Knowing the resistance offered by bodies in rotation when compelled to change the direction of their axes, it might be thought that this rotation is the result of the diurnal rotation, but it is not confined to the earth. The lunar orbit and consequently the moon itself are affected by this same rotation, and in analyzing the movements of the system composed of the earth and moon, we see that this annual rotation could take place even if the diurnal rotation were stopped. Its cause lies only in the liberty with which the earth plays around its center of gravity, on which the central forces act. It is the natural consequence of the movement of the system around the sun.

This study leads us to interesting statements regarding central forces. Newton said that if the central forces were equal they would destroy celestial movements, and if they were unequal they would produce chaos. He seems to have stated a dilemma from which there can be no escape.



S, sun; O, planetary orbit.

In passing from A to B the planet describes an arc which produces centrifugal force. This overcomes gravity and drives the planet along the tangent C. The centrifugal force ceasing here, gravity acts again and brings back the planet over the arc DA where the centrifugal force again originates and the same effects are repeated.

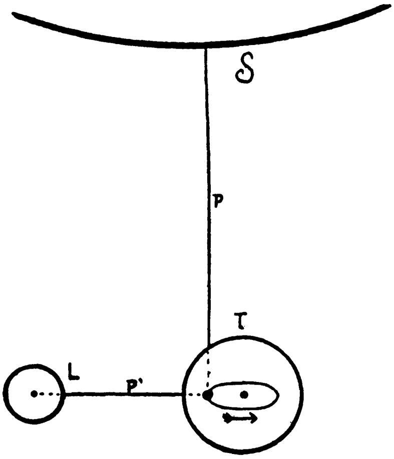
The recognition of this rotation and the analysis of the celestial movements give the key of this mystery, and the following law which is easily verified may be formulated:

Central forces act upon each other alternately in infinitely short lengths of time at the point where they are in equilibrium.

In reality the central forces never cease acting upon each other but their work is alternately effective. It is this alternative work which assures regularity and indefinite duration to the movements of celestial bodies.

Accordingly we recognize two rotations of the earth. Let us try to find the third, but before leaving the retrograde rotation, it is well to consider its motion with relation to the earth-moon system.

This rotation is effected by both bodies turning together around the same pivot. Now the conditions of equilibrium require that this pivot should be placed not in the center of the earth but in the center of gravity common to both bodies. This center of gravity lies about 1700 kilom. from the surface of the earth and 4600 kilom. from its center. But as a result of the change of position of the moon this common pivot is in perpetual motion around the center of the earth, or to be more precise, the center of gravity of the earth is in perpetual rotation around the common center of gravity upon which act the central forces.



S, sun; T, earth (*Terre*); L, moon (*Lune*); P, P', the force of gravity (*pesanteur*).

The movement of the common center of gravity of the earth-moon system causes the principal irregularities in the movements of the heavenly bodies.

The movements of the two bodies around their common pivot are very complex. It is these which have caused the principal irregularities. Indeed these alone are the cause of the precession, the retrogression of the nodes of the moon, the nutation, the oscillation of the lunar orbit, libration etc.

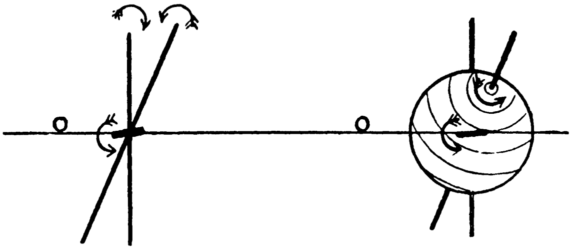
This hypothesis invalidates the theory of d'Alembert on the subject of the precession of the equinoxes which he attributes to the action of the sun on the swelling of the meniscus of the earth. Any number of objections to the theory of d'Alembert may be adduced, but the most important is that this theory contradicts Newton's law. It must be abandoned because it is false in that it makes the central forces act otherwise than on the centers of bodies.

The movement of precession is caused by the alternative action of central forces upon the common center of gravity of the earth-moon system. It is the logical consequence of their equilibrium around this pivot. The central forces acting constantly in the interior of the earth upon an eccentric instead of acting upon its center of volume, have a tendency to displace the direction of the axis of diurnal rotation.

The meniscus of the earth has no more to do with the movement of precession than has the diurnal rotation. The movement of precession is an irregularity in the annual retrograde rotation. Accordingly we are already familiar with the fact that the earth has two axes of rotation about itself, but we know that a body moving freely around its own center of gravity can turn around three axes.

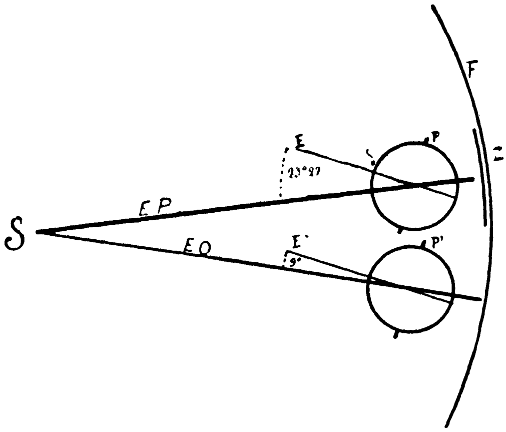
If we compare the earth to an ordinary body in motion we can determine geometrically with the greatest exactness the position of the third axis, since we know the positions of the two first. Only one position is possible for it.

We see that this axis must be in the plane of the orbit from which it can never deviate. Its equator must have in its plane the two poles of the axis of diurnal rotation that we call the poles of the earth. In this way a movement of the earth around the third axis must determine a latitudinal change of place of the two poles of the earth. An astronomical movement observed for more than four thousand years and known under the name of the "diminution of the obliquity of the ecliptic," has been plausibly attributed to the equator. Its effect has been to change the latitudinal position of the poles.



O, orbit.

Geometrical position of the three axes and the direction of the angular rotations.



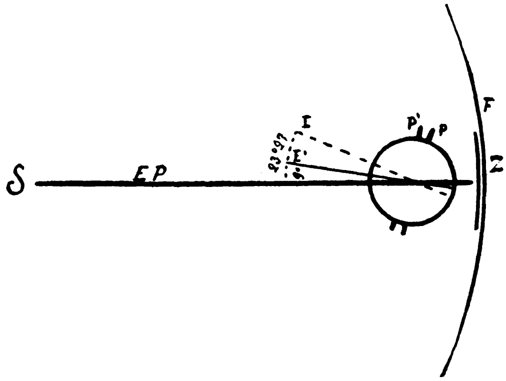
MOVEMENT KNOWN AS DIMINUTION OF OBLIQUITY.

Wrongly attributed to the earth's orbit.

The obliquity at present is 23° 27′. As it decreases, the earth and its orbit would have to vary from the general law of the planets and would move from EP towards EO, which is impossible.

This movement had been attributed to the ecliptic since its discovery without profound investigation, and on this hypothesis Laplace and Leverrier have rightly limited its extent. They have not considered the hypothesis in which the movement would belong to the equator. In that case they would be able to limit neither its extent nor duration.

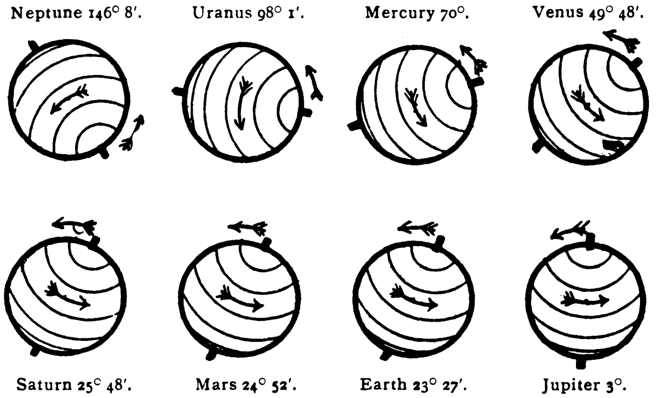
We know that the first two rotations are common to all the planets. All the planets indeed, like the earth, have their diurnal rotation and their annual and retrograde rotation, though with different angular velocities. These have been established by observation. The third rotation must be observed like the others in the other planets. As its effect is to modify the angle of inclination of the axes of diurnal rotation on the planes of the orbits, these axes must be taken at any time in their rotation and in the greatest variety of angles of inclination. This indeed is what we have acquired through observation. Jupiter's axis is inclined at only 3°, Mars at 24° 52′, Saturn at 25° 48′, Venus at 49° 48′, Mercury at 70°, Uranus at 98° 1′, and Neptune at 146° 8′, but we know that the satellites share all the movements of the planets, and we know in mechanics that if a rotary movement of a pole takes place from left to right, the same movement from the opposite pole takes place from right to left.



DIMINUTION OF OBLIQUITY.

If this movement is attributed to the earth itself instead of to its orbit, there is no need to vary from the general law of the planets, and the axis need move only from P to P′ to produce a diminution equal to that of the preceding figure.

Again we know that the satellites of Uranus and Neptune have a retrograde movement. Now if we observe the large angle of inclination of the axes of rotation of Uranus and Neptune we will notice that these planets appear to us in the same position in which the earth would be if its south pole occupied the place of its north pole in its projection in the midst of the stars. In this position the moon would appear to the inhabitants of Mars, for instance, to turn in the retrograde direction. This change of rotation which has so greatly perplexed the astronomers would accordingly be most natural. It is the logical consequence of a complete latitudinal rotation of the planets, bearing their satellites with them.



LATITUDINAL MOVEMENT OF THE AXES.
Shown by the different positions of the planets.

These three known rotations moreover can establish the definition of our globe as follows:

The earth is a spheroid of revolution, slightly oblate, moving freely around its center of gravity, circulating in space around the sun and turning upon itself simultaneously with different angular velocities around three axes of rotation.

We know the angular velocity of these three rotations:

the first and most rapid takes place in twenty-four hours; the second, less rapid, takes place in a year; the third is extremely slow and observations unite in assigning to it a velocity of 48″ a century. Its rotation therefore would be accomplished in about 2,700,000 years.

This rotation can never be observed either in the heavens or on earth except by the traces which it may leave and by the observations which we will hand down to our descendants, but it can be easily demonstrated by the laws of mechanics, that the observed movement can have no other cause.

After having found the effects of this third rotation in the different angles of inclination of the planets and in the opposite rotations of the satellites it remains to discover evidence of it upon the earth itself, and this is found in gradual variation of climate.

Then, too, I can not help admiring the admirable order of Nature in which all her wonders seem to form such a marvelous whole. Has she not combined perfect movements with the ideal form of heavenly bodies? A sphere is the most simple, the natural form. No other shape can better hold together the constituent molecules in a state of stability according to the universal law of gravitation. No form could leave a body its absolute liberty around its center of gravity better than the spherical form. But if the spherical form is the ideal form of homogeneity and stability it lends itself but poorly to a regular distribution of the caloric and luminous rays of the sun on its entire surface. Although a small part receives vertical rays most of its great surface receives the rays from an oblique direction and half of the entire surface is completely deprived of them. What means, then, has nature taken to distribute light and heat upon all the surface of the spherical body? By making it revolve around itself.

But if it turned around only one axis it would still have large surfaces at the extremities of that axis which would never receive the light. If it turned around only two axes, which might moreover injure its stability, the distribution of light would still be incomplete, but it turns around three axes, that is to say in all directions at one time.

The earth needs light and heat as much as vegetables and animals, but since its form does not permit all portions of it to be heated at one time it presents them one after another to the life-giving sun.

To sum up the three rotations: the first rotation (diurnal and nocturnal); the second rotation, of which the movement known under the name of the precession of equinoxes is an irregularity (annual and retrograde); the third rotation (secular) is incorrectly attributed to an oscillation of the earth's orbit when in reality it is the result of the movement of the earth about itself.

P. BEZIAU.

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